PROGRIS RIPORT 8

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`itehu:~kotani/glast/txt/001106.kotani2.riport8`

1 Have Done

- Found that the number of remaining BGD events increases as the quantum efficiency decreases, just as estimated by the tile-missing ACD model.
- Found that a gap narrower than 1 cm does not matter so much.

2 Quantum Efficiency

The performance of the ACD with a quantum efficiency of 0.999 and 0.99 was studied. The ratio of BGD events remaining after L1T, L2T, L3T and the New-DOCA filter was used as an Figure of Demerit. Other filters which use no ACD information are ignored.

During the tests, a bug in the simulation code was found. It made the output parameter No_Vetos_Hit have non-zero value however small the input parameter QE was. It was fixed by Heather and the revised source VetoData.cxx 1.12.2.2 were used for further tests. Previous simulations including QE = 1 and that of the two-tiles-missing model (Riport 7) were run with the bug. Because the QE has been nominally set to 0.9997, which is near 1, and because the bug affect only the New-DOCA filter but not the low-level triggers, it presumably does not matter. The resultant FoD is shown in Fig. 2.

All 4 data points are roughly on a line. From a fit to the 4 data points, the dependence on the QE is expressed as

$$\begin{aligned} \text{Remaining BGD} &= 3.593 \times 10^{-3} - 9.594 \times 10^{-2} \times \text{QI} \\ &= 3.593 \times 10^{-3} - 1.304 \times 10^{-6} \times (\text{total area} - 73600\ (\text{cm}^{-2})), \end{aligned} \tag{1}$$

where QI (Quantum Inefficiency) is defined as 1−QE. I hope this expression is easier to understand than that in Riport 7.

3 Remaining BGD Ratio vs. Gap

The performance of the ACD with a gap of 1 mm, 2 mm, and 4 mm was studied. The ratio of BGD events remaining after L1T, L2T, L3T and the New-DOCA filter was used as an Figure of Demerit. Other filters which use no ACD information are ignored.

During the tests, a bug in the simulation code which causes error messages "bad geometry for surface" was found. It was fixed by Heather and the revised sources ACDTopMed.cxx 1.5.2.2 and ACDSideMed.cxx 1.4.2.3 were used for further tests. The QE was set to 1. The resultant FoD is shown in Fig. 2.

As seen, the effect of the gap is small compared to that of missing tiles and thus the QE. The total area of a gap of d cm is approximately

$$\text{area} = 5000 \times d \quad \text{cm}^2.$$

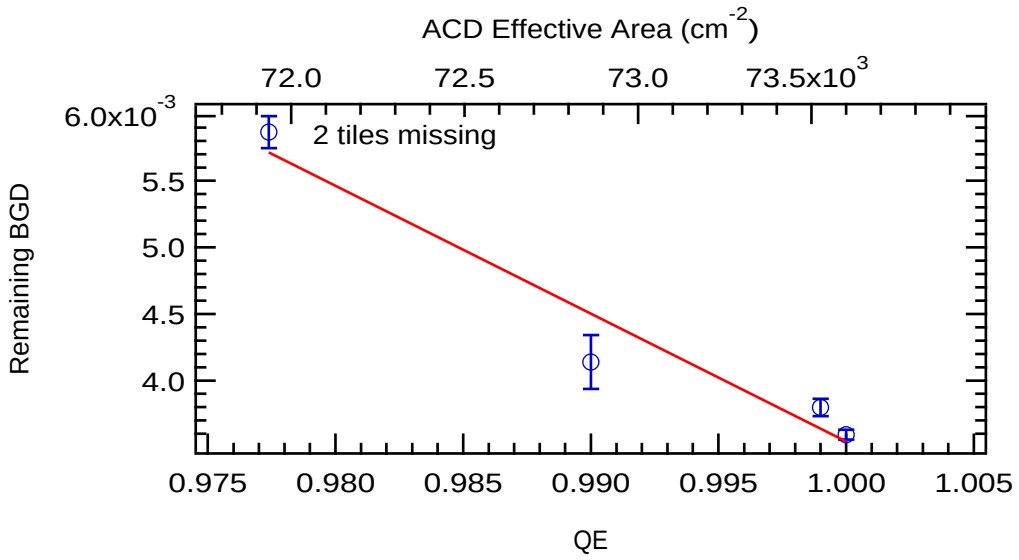

Figure 1: Remaining BGD events vs. QE
The ratios of remaining BGD events after the New-DOCA filter with a statistical 1 σ error bar are plotted. The top axis is the corresponding effective area. The data of the two-tiles-missing ACD model is also plotted in terms of effective area. The nominal data referred as 4-ROW ACD in previous reports is plotted at QE = 1, even though the QE parameter was set to 0.9997. See text for more explanation. The line fitted to all 4 data points is plotted.

So, the total area of the 4 mm gap is 2000 cm^{-2}, which is larger than the area of the missing 2 tiles in Riport 7. However, the 4 mm gap increase the remaining BGD event ratio only by 8 %, a quite small value. Why doesn't the gap degrade the performance of the ACD? Probably BGD particles, which isotropically bombers the GLAST, can not go through the gaps of the tiles with an thickness of 1 cm, unless the injection angle is almost normal to the tiles. If that is true, a gap wider than 1 cm would degrade the performance much more and be out of the extrapolation line in Fig. 2. I'm not sure i should investigate on the effect of a gap wider than 1 cm, which is not a plausible design.

It should be noted that the current simulation code ignores the deposit-energy dependence of the QE. If a particle hits a 1-cm side of an ACD tile and leaves a path shorter than 1 cm, the deposit energy and thus the detectability would be smaller. Many of the particles going through a gap are considered to make such an event. Therefore, a gap may degrade the BGD ejection ratio worse than shown in Fig. 2.

4 To Do

- Study the effect of a gap wider than 1 cm, but anybody interested?
- Install a new fast machine with a large storage.
- Check the reliability of the low-energy interaction in the simulation code.

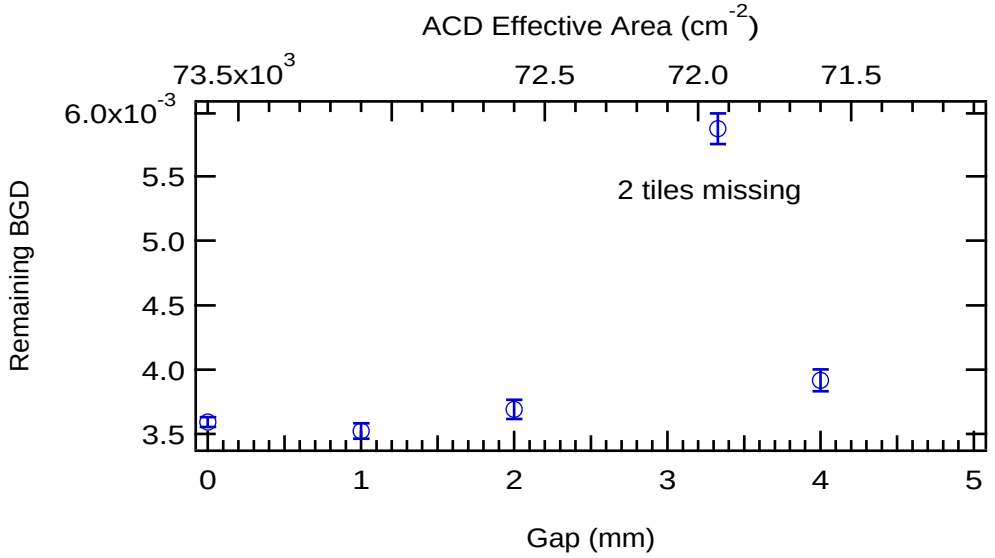

Figure 2: Remaining BGD events vs. gap
The ratios of remaining BGD events after the New-DOCA filter with a statistical 1 σ error bar are plotted. The top axis is the corresponding effective area. The data of the two-tiles-missing ACD model is also plotted in terms of effective area.
The data points at 0 mm, 1 mm and 2 mm were obtained with the simulation code with a bug. The point at 4 mm was obtained after the bug fix. I don't suppose that the effect of the bug is serious, because the error occurred at a rate of only 3×10^{-3}, in the case of the gap of 1 mm and 2 mm.